1) INTEGRATION OF POLYNOMIALS

RULE: $\int ax^n \; dx = a \cdot \frac{x^{n+1}}{n+1} + c$ *add 1 to the power, divide by the new power

$\int a \; dx = ax + c$

Examples: Integrate the functions below

1) $\int 5x^6 \; dx$

$= 5 \cdot \frac{x^{6+1}}{6+1} + c = \frac{5}{7}x^7 + c$

2) $\int 4x^3 - 5x^2 + 6x - 7 \; dx$

$= 4 \cdot \frac{x^{3+1}}{3+1} - 5 \cdot \frac{x^{2+1}}{2+1} + 6 \cdot \frac{x^{1+1}}{1+1} - 7x + c = x^4 - \frac{5}{3}x^3 + 3x^2 - 7x + c$

3) $\int (x-3)(x+5) \; dx$

$= \int x^2 + 2x - 15 \; dx = \frac{x^{2+1}}{2+1} + 2 \cdot \frac{x^{1+1}}{1+1} - 15x + c = \frac{x^3}{3} + x^2 - 15x + c$

4) $\int \frac{3x^5 - 2x^4}{6x^2} \; dx$

$= \int \frac{3x^5}{6x^2} - \frac{2x^4}{6x^2} \; dx = \int \frac{1}{2}x^3 - \frac{1}{3}x^2 \; dx = \frac{1}{2} \cdot \frac{x^{3+1}}{3+1} - \frac{1}{3} \cdot \frac{x^{2+1}}{2+1} + c = \frac{1}{8}x^4 - \frac{1}{9}x^3 + c$

2) FINDING CONSTANTS OF INTEGRATION

To find the value of the constant of integration, we need to have some extra information. This is usually a pair of coordinates.

Example: If $f'(x) = 3x^2 - 4x + 6$, find $f(x)$ given that $f(1) = 8$.

[*meaning (1, 8) is a coordinate of f(x)*]

$f(x) = \int 3x^2 - 4x + 6 \; dx = 3 \cdot \frac{x^{2+1}}{2+1} - 4 \cdot \frac{x^{1+1}}{1+1} + 6x + c = x^3 - 2x^2 + 6x + c$

So $f(x) = x^3 - 2x^2 + 6x + c$

Since $f(1) = 8$: $1^3 - 2 \cdot 1^2 + 6 \cdot 1 + c = 8$

$1 - 2 + 6 + c = 8$

$c = 3$

Therefore $f(x) = x^3 - 2x^2 + 6x + 3$

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